Proposal for the management of **temporal and semantic components** of Geographic Information

Abstract

This poster raises the issue of a research work oriented to the storage, retrieval, representation and analysis of dynamic GI, taking into account the semantic, the temporal and the spatiotemporal components. We intend to define a set of methods, rules and restrictions for the adequate integration of these components into the primary elements of the GI: theme, location, time [1]. We intend to establish and incorporate three new structures (layers) into the core of data storage by using mark-up languages: a semantic-temporal structure, a geosemantic structure, and an incremental spatiotemporal structure. The ultimate objective is the modelling and representation of the dynamic nature of geographic features, establishing mechanisms to store geometries enriched with a temporal structure (regardless of space) and a set of semantic descriptors detailing and clarifying the nature of the represented features and their temporality. Thus, data would be provided with the capability of pinpointing and expressing their own basic and temporal characteristics, enabling them to interact each other according to their context, and their time and meaning relationships that could be eventually established.

Keywords

Spatiotemporal reasoning, GIS, time, geosemantic, dynamic storage, metamodel, incremental storage.

Description of the problem

At the present time the models and data store systems of GI manage the time variable inefficiently in regard to users' needs, most particularly the possibility of carrying out analyses and a follow-up of the geographic features as a continuum.

CR = $\{t_0, t_1, t_2, t_3, \ldots\ldots\ldots\ldots, t_n \quad / \quad t_0 \neq t_1 \ \ldots\ldots \neq \ldots\ldots, t_n\}$

where: t_0 → Initial reality. (Photo *0*)
t_n → Reality in a subsequent time *n* (Photo *n*)

Current Reality

The fact that the set *CR* is defined by multiple elements and the number of these elements increases over time as the changes are registered implies multiple drawbacks.

Lack of a binding historical register of the represented features.

Users do not achieve the desired answers from the spatiotemporal analyses carried out.

Inability to develop real spatiotemporal analyses.

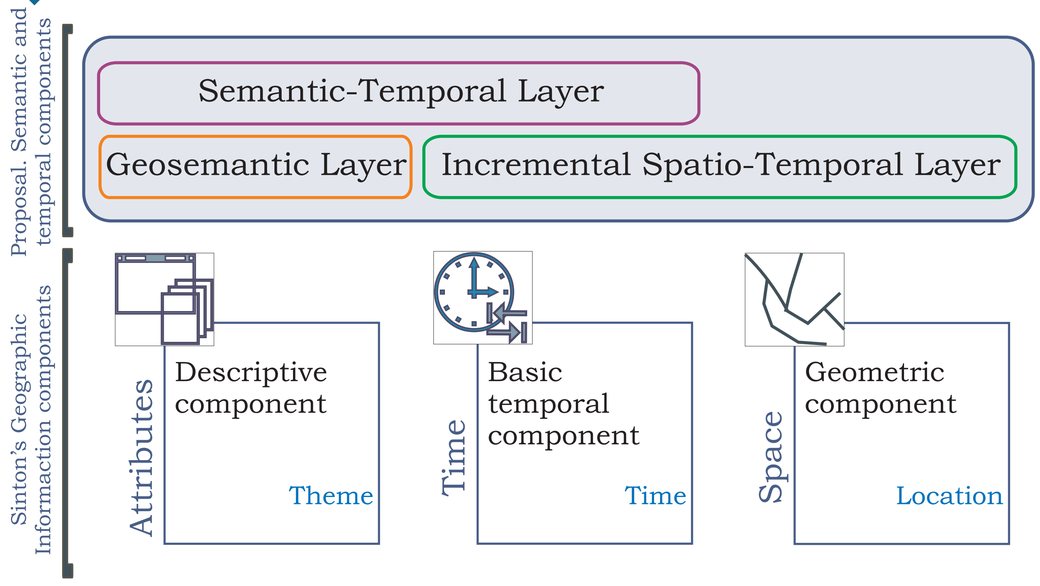
Attribute ⇒ space ⇒ time relationships without one-to-one matching.

Inability to find other related levels of information or associated geographic features.

Duplication of GI and lack of data versions (releases).

Unnecessary package traffic on the computer networks derived from data duplication.

Proposal



This work would optimise the register of geographic information through a new storing structure avoiding information duplication. Furthermore, it would permit to know the reality of a registered geographic feature at any time. We intend to provide data with semantic elements that should in turn describe them by using mainly available standards and specifications.

PR_0 = t_0 +/- δt;

PR = $\{PR_0, S\}$; → $\{(t_0 +/- \delta t) \ / \ S \in PR \ \wedge \ \forall$ one and only one $S\}$

where: t_0 → Initial reality.
δt → Spatiotemporal change of reality (t_x). Spatiotemporal factor. Incremental representation.
S → Semantic descriptor.

Proposed Reality

Conclusion

The semantic and temporal enrichment of the GI and its implementation through mark-up languages for their integration into the GI management systems is the next natural step in the research carried out on the space-time issue in the Information Systems. It is necessary to carry on with the work of all the researchers who have contributed some element to lay the foundations of the change in the paradigm toward the temporal analysis of GIS and the semantic interpretation of GI.

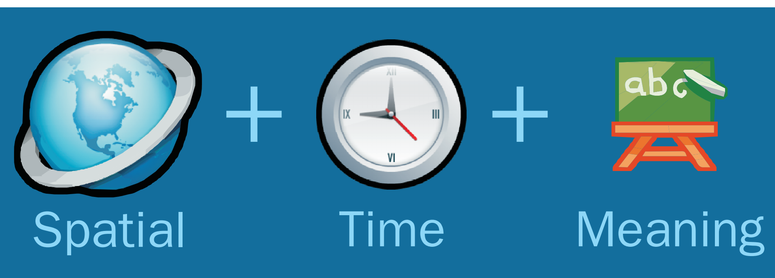
This proposed research work is warranted since it is anticipated to make progress, (**i**) setting up mark-up languages as an integrating element of the spatial, temporal and semantic elements; (**ii**) adding further descriptions to data, and (**iii**) developing concepts enabling progress in geosemantics.

The innovation of this research work lies in the proposal of a metamodel for representation, retrieval, reasoning and spatiotemporal and semantic analysis of GI. The anticipated contributions to be gained from this research are:

- Metamodel enabling exploitation of the GI dynamic component.
- Method for incorporation of the semantic component into the GI storage structure.
- Method for integration of an independent temporal component into the GI.
- New format for the GI integrating the temporal, spatial, and attribute components, providing a semantic-temporal support.
- Implementation of mark-up language-based storing spatiotemporal structures.

References

[1] Sinton, D. F.: <<The inherent structure of information as a constraint to analysis: Mapped thematic data as a case study>> en: *First International Advanced Study Symposium on topological data structures for Geographic Information Systems*, Cambridge - USA:Harvard University Laboratory for Computer Graphics and Spatial Analysis, pp.1-17, 1978



Willington Siabato
Miguel-Ángel Manso-Callejo
Technical University of Madrid
Mercator Research Group

STDM 2011. International Symposium on Spatial-Temporal Analysis and Data Mining.